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(54) Title: AN EFFICIENT PROCESS FOR THE MANUFACTURE OF TOMATO PRODUCTS					
(57) Abstract					
<p>A process for the exploitation of tomatoes and the manufacture of tomato products, comprises the steps of: a) Pretreating the tomatoes by washing, crushing, and removing waste materials such as peels and seeds; b) Separating the serum from the pulp; c) Dividing the pulp as follows: "A" parts of the pulp being used as a pulp product or as a raw material for pulp products; "B" parts of the pulp being sent to an extraction step; d) Extracting the fraction "B" of the pulp, to produce extracted tomato oleoresins; e) Using the extracted pulp obtained in step (d), as a raw material for food products; f) Removing "C" parts of the serum obtained in step (b), to be used as food product or as a raw material for food products; g) Concentrating the remaining serum to yield a concentrate of soluble tomato solids; h) Removing "D" parts of tomato soluble solids to be used in the preparation of food products, wherein: A = 0 to 1; B = 0 to 1; C = 0 to 1; D = 0 to 1; i) Optionally, drying the concentrate of step (g) to yield a powder; and j) Varying the values of A, B, C and D so as to obtain the desired amount of pulp products, tomato oleoresins, nutritional fibers products, serum products and serum concentrate, at any given time.</p>					
<pre> graph TD Tomato --> Wash["Washing, size reduction, Cutting"] Wash --> Centrifuge["Centrifugal Separation"] Centrifuge --> Serum["Serum"] Serum --> Concentrate["Serum Concentration"] Concentrate --> TomatoSolids["Tomato soluble solids concentrate"] TomatoSolids --> Dehydrated["Dehydration"] Dehydrated --> DehydratedTomato["Dehydrated Tomato soluble solids"] TomatoSolids --> Freeze["Freezing, etc."] Freeze --> Products["Products"] Serum --> FoodC["Food Products"] Serum --> PulpA["Pulp Products"] PulpA --> Pulp["Pulp"] Pulp --> Extraction["Extraction"] Extraction --> TomatoOleoresin["Tomato Oleoresin"] Extraction --> Insoluble["Tomato Insoluble Solids"] Insoluble --> Freeze Insoluble --> DehydratedTomato </pre>					

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AN EFFICIENT PROCESS FOR THE MANUFACTURE OF
TOMATO PRODUCTS

Field of The Invention

The present invention relates to the field of food processing. More particularly, the invention relates to an efficient process for the manufacture of tomato products.

BACKGROUND OF THE INVENTION

Tomato products are widely used in the food industry, and a number of processes have been proposed and are currently used for manufacturing various tomato products. Such tomato products include, e.g., tomato concentrates, tomato juice, and tomato powder. Lately, lycopene, the red pigment of tomato, has become of substantial interest as a natural coloring material for food products. In a copending patent application filed by the same applicants herein, the use of tomato pulp, which is rich in lycopene, is described for direct coloring of food products.

Furthermore, in view of the increasing importance of the tomato as a raw material for the food industry, efforts have been made to breed industrial tomatoes of improved quality. One such development relates to a variety which contains a higher content of lycopene.

One problem encountered in the art is that of producing tomato products of constant color. In order to achieve this goal, the food industry needs tomato of constant quality, particularly of constant color, but has to deal

with raw material of constantly changing properties. This is a considerable problem since the shade of the tomato changes in different seasons, depending on weather conditions, location and growth conditions, and differs from one variety of tomato to another. This problem has not yet been fully solved by the food industry, although a number of solutions have been attempted.

The Prior Art

Many processes are known in the art, for manufacturing various tomato products from tomato. In conventional processes, tomato paste is produced from tomato juice by vacuum concentration. U.S. Patent No. 3,172,770 relates to a process for preparing tomato concentrate by means of crushing of tomatoes and centrifugal separation of the obtained juice into pulp and serum, which is subsequently further manipulated by concentration, freezing and other preservation methods.

Summary of the Invention

It is an object of the invention to provide a highly flexible process for the exploitation of tomatoes, which permits to manufacture a variety of end products in a single production process.

It is a further object of the invention to provide a process which permits to exploit parts of the tomato in a manner which was not customary in the art before the invention. Particularly, tomato oleoresin, soluble and insoluble tomato solids which are efficiently and conveniently exploited by the process of the invention.

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The process according to the invention, for the exploitation of tomatoes and the manufacture of tomato products, comprises the steps of:

- a. Pretreating the tomatoes by washing, crushing, and removing waste materials such as stems and foreign bodies;
- b. Separating the tomato serum from the pulp;
- c. Distributing the pulp as follows:
 - "A" parts of the pulp being used as a pulp product or as a raw material for pulp products;
 - "B" parts of the pulp being sent to an extraction step.
- d. Extracting the fraction "B" of the pulp, to produce tomato oleoresin;
- e. Using the extracted pulp obtained in step (d), as a raw material for food products;
- f. Removing "C" parts of the serum obtained in step (b), to be used as serum product or as a raw material for food products;
- g. Concentrating the remaining serum to yield a concentrate of soluble tomato solids;

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h. Removing "D" parts of tomato soluble solids to be used in the preparation of food products;

wherein:

A = 0 to 1

B = 0 to 1

C = 0 to 1

D = 0 to 1;

i. Optionally, drying the concentrate of step (g) to yield a powder; and

j. Varying the values of A, B, C and D so as to obtain the desired amount of pulp products, tomato oleoresins, nutritional fibers products, serum products and serum concentrate, at any given time.

The drying of the concentrate of tomato solids (step (i)), can be effected by any suitable dehydration technique. For instance, spray drying can be used, to obtain a powder from the said concentrate. The spray drying can be effected in the presence of additives that facilitate drying, or of other additives which it is desired intimately to admix with the tomato solids, or co-dried with tomato juice or paste.

The extracted pulp obtained in step (d) still contains a high water content. Typically, such pulp contains (on a weight basis) about 80% H₂O and 20%

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insoluble solids. This pulp can further be dehydrated to obtain tomato fibers.

The extraction solvent should be a solvent which can be used in the food industry, and which is not hazardous to health. According to a preferred embodiment of the invention, the solvent is selected from among hexane, dichloromethane, acetone, butyl acetate, diethyl ether, ethanol, ethyl acetate, methyl acetate, methanol, propane and their mixtures.

As will be apparent to the skilled engineer, the process of the invention permits to provide a fine tuning of the quality of the final product, by controlling the output of the other products, as will be illustrated more specifically below.

Step (a) includes all conventional pretreatment steps, which are customary in the tomato industry, and is not necessarily limited to washing, crushing and removing waste materials. However, since as stated these steps are conventional, they are not discussed herein in detail, for the sake of brevity.

Likewise, the separation step (b) can be carried out in any suitable apparatus, e.g. in a centrifuge, in one or more stages.

The process of the invention can be carried out with any variety of tomato, but it is particularly desirable to employ high lycopene-containing varieties. The higher the content of lycopene in the tomato, the greater

the flexibility of the process and the ability to control the amounts of the various materials which are produced at a given time. Therefore, tomatoes containing at least 50 ppm of lycopene are preferred as raw materials of the process, although as stated the process operates with any variety of tomato. However, as said, the invention is not limited to any particular variety of tomato. As will be apparent to the skilled person, one of the important aspects of the invention is the way in which the tomato is separated into soluble tomato solids, insoluble tomato solids and oleoresin, all of which is further exploited. This separation was not done before in the art, and is of course not limited to any particular type of tomato.

The above and other characteristics and advantages of the process of the invention will be better understood through the following illustrative and non-limitative description of a preferred embodiment.

Brief Description of the Drawing

Fig. 1 is a flow chart of a process, according to one possible embodiment of the invention.

Detailed Description of Preferred Embodiments

The figure illustrates the various manufacture steps, in block diagram. The tomatoes entering the process are pretreated by washing, crushing, removing waste materials such as stems or foreign bodies, or the like operations. The output of the separation step, which is fed to the process, consists of two streams: tomato serum and tomato pulp.

Looking first at the right-hand branch, the pulp is distributed as follows:

- A parts of the pulp are used as a pulp product or as a raw material for pulp products. The pulp has a number of uses as such, as a raw material for other tomato-related processes, or as a raw material in the preparation of pulp-derived natural coloring material for food products.

- B parts of the pulp are sent to an extraction step. In the extraction step tomato oleoresin is extracted from the tomato pulp, by any suitable extraction process, e.g., by extraction with solvents. The tomato oleoresin contains a high concentration (about 2% - 10% by weight) of lycopene, which can be used as a natural coloring material, e.g., in drinks, foodstuffs, cosmetics, etc.

The solid fraction remaining after the extraction step is a slightly colored pulp, which contains mainly insoluble tomato solids. This material is rich in dietary fibers and can be used as such, for the preparation of foodstuffs, as an additive or ingredient, and can further be used as a basis for the preparation of tomato products.

Accordingly, in another aspect the invention is directed to the use of insoluble tomato solids as a basis for foodstuffs.

The serum separated in the early centrifugation step is a valuable product as well, since it is used as an ingredient in other tomato products.

Thus, in the scheme shown in the figure C parts of the serum obtained from the centrifugation step are removed, to be used as serum product or as a raw material for serum products. The remaining serum is concentrated to yield serum concentrate. Serum concentrate has a variety of uses, e.g., is used in the preparation of tomato soups, beverages, etc. The tomato serum contains soluble tomato solids, useful in a variety of food products. As stated above, these soluble tomato solids can further be dehydrated, e.g., into powder form, and used as such.

Example

10,000 Kg of tomato containing 100 ppm lycopene were processed according to the process of the invention. After washing, crushing and waste separation, 9,500 Kg of processable material remained. The material was fed to a decanter (Westfalia CA-365-010, revolution speed 4,000 rpm) and separated into two streams: tomato pulp (900 Kg) and tomato serum (8,600 Kg). The serum contained 10 ppm lycopene and was further centrifuged in an Alpha Laval centrifuge (BRPX617SFV-31 CGL-50) at 4050 rpm, to give a 5 ppm of lycopene-containing serum. The pulp can be used separately or unified, as desired. The serum was concentrated by evaporation under reduced pressure and temperature, to give a final weight of 710 Kg soluble tomato solids concentrate at 60°Bx. 310 Kg were used as such, as an additive to vegetable drinks, and 400 Kg were mixed with tomato juice and further processed by spray-drying. The resulting dry powder (237 Kg) was used as a basis for the preparation of tomato soup.

The 900 Kg of tomato pulp were divided into ten 90 Kg portions. Each 90 Kg portion was extracted with 250 Kg of warm (50°C) dichloromethane. After evaporation of the solvent 1150 gr of tomato oleoresin were obtained. The solvent was removed by azeotropic distillation. The extracted pulp (still about 90 Kg) was fed to a dehydration step (drum dryer) from which 18 Kg of insoluble tomato solids were obtained. This product was later used as an ingredient for cereals, baked products, health food bars, food products rich in dietary fibers, etc.

As will be apparent to the skilled person, the process of the invention renders it possible to operate in a very flexible manner, either in continuous or batchwise, to obtain the desired product with the required quality, in a very efficient manner. The process is rendered highly efficient by the ability to vary the various proportions of the different streams at will, within the limits detailed above.

As will be apparent to the skilled person the process of the invention is unique insofar as it exploits the tomato in its entirety. The description given above refers, for the sake of simplicity, to a limited number of end streams. It is clear, however, that additional streams can be created, to obtain additional end products. Accordingly, the invention is not limited to such exemplified products, and is intended to encompass all equivalent processes. Thus, many modifications can be effected by the skilled engineer in the various streams, methods, equipment and products described above, without exceeding the scope of the invention.

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CLAIMS

1. A process for the exploitation of tomatoes and the manufacture of tomato products, comprising the steps of:
 - a. Pretreating the tomatoes by washing, crushing, and removing waste materials such as peels and seeds;
 - b. Separating the serum from the pulp;
 - c. Dividing the pulp as follows:
 - "A" parts of the pulp being used as a pulp product or as a raw material for pulp products;
 - "B" parts of the pulp being sent to an extraction step.
 - d. Extracting the fraction "B" of the pulp, to produce extracted tomato oleoresins;
 - e. Using the extracted pulp obtained in step (d), as a raw material for food products;
 - f. Removing "C" parts of the serum obtained in step (b), to be used as food product or as a raw material for food products;
 - g. Concentrating the remaining serum to yield a concentrate of soluble tomato solids;

h. Removing "D" parts of tomato soluble solids to be used in the preparation of food products;

wherein:

A = 0 to 1

B = 0 to 1

C = 0 to 1

D = 0 to 1;

i. Optionally, drying the concentrate of step (g) to yield a powder; and

j. Varying the values of A, B, C and D so as to obtain the desired amount of pulp products, tomato oleoresins, nutritional fibers products, serum products and serum concentrate, at any given time.

2. A process according to claim 1, wherein the separation step (b) is carried out by centrifuging or pressing or filtering.

3. A process according to claim 1, wherein the soluble tomato solids are dehydrated by spray-drying, with or without additives.

4. A process according to any one of claims 1 to 3, wherein tomato is a high lycopene containing tomato.

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5. A process according to claim 4, wherein the tomato contains at least 50 ppm of lycopene.
6. Use of insoluble tomato residues remaining after the extraction of tomato oleoresin from tomato pulp, as an ingredient for food products.
7. A process for the exploitation of tomatoes, comprising separating the tomato into three separate streams, the said streams being: oleoresin, soluble tomato solids, and insoluble tomato solids.
8. A process for the exploitation of tomatoes, essentially as described and illustrated.

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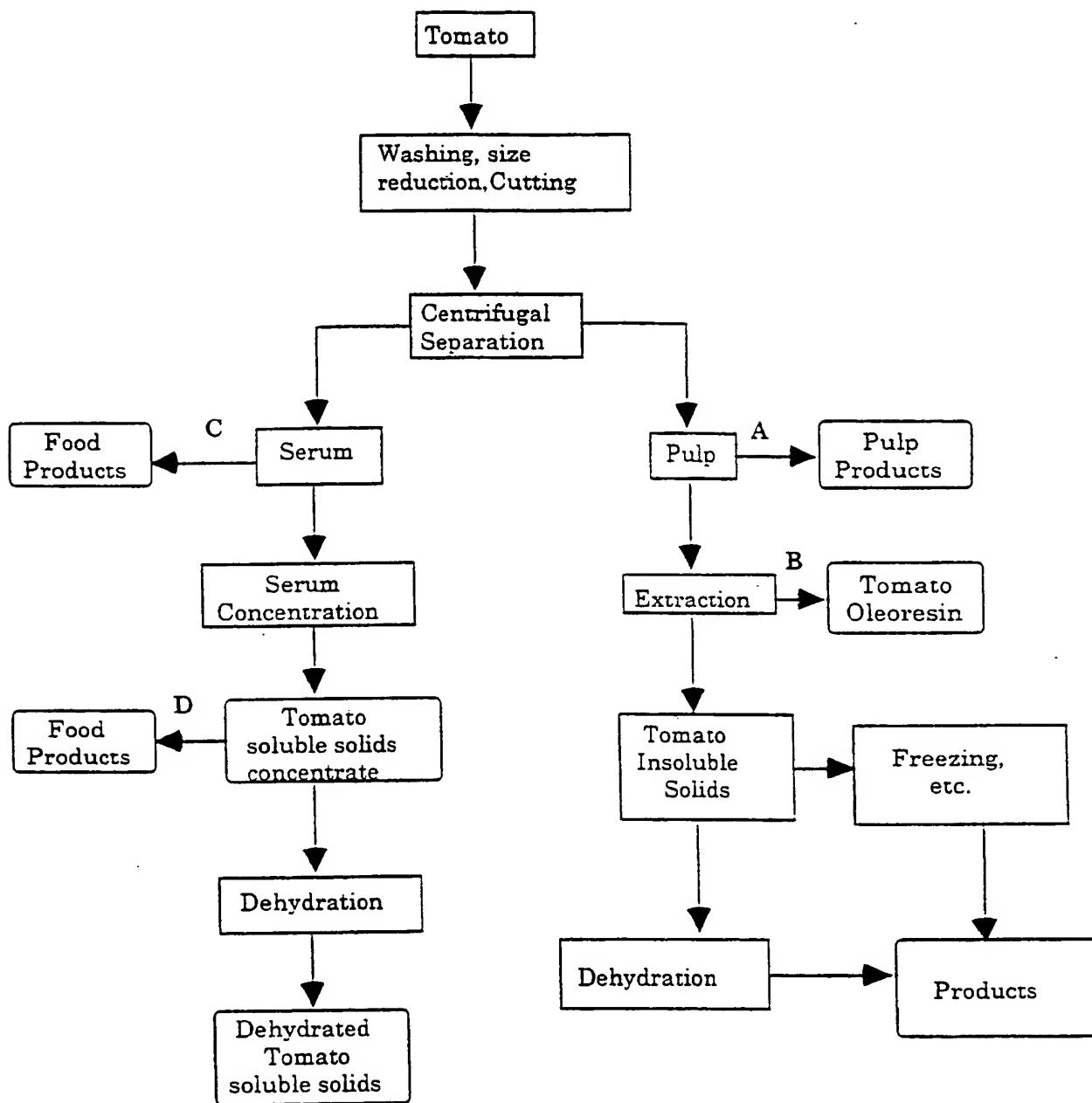


Fig. 1

INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/US 94/14264

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A23L1/212 A23L1/275 A23L1/00 A23B7/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23L A23B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>INTERNATIONAL FOOD INGREDIENTS, vol. 6, 1993 pages 45-51, ZOHAR NIR ET AL. 'Lycopene from tomatoes' see page 46</p> <p>---</p> <p>US,A,5 245 095 (GRAVES FREDERIC A ET AL) 14 September 1993 see column 1, line 39 - line 47 see "summary" see column 4, line 51 - line 68</p> <p>---</p> <p>EP,A,0 608 027 (MAKHTESHIM CHEM WORKS LTD) 27 July 1994 see page 3, line 51 - page 4, line 39</p> <p>---</p> <p>-/-</p>	1-8
X		1-8
P,Y		1-8

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

18 April 1995

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24.05.95

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INTERNATIONAL SEARCH REPORT

Internal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 470 923 (I M I T A C) 12 February 1992 see page 5, line 44 - line 51 ---	1-8
Y	JOURNAL OF FOOD SCIENCE, vol. 47,no. 6, 1982 pages 1853-1858, M.C.DALE ET AL. 'Concentration of Tomato Products: Analysis of Energy Saving Process Alternatives' see page 1853 ---	1-8
Y	IFST PROCEEDINGS, vol. 14,no. 1, 1981 pages 15-27, P.GOOSE 'Developments in the production of primary tomato products' see page 26, paragraph 1 -----	1-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal	Application No
PCT/US 94/14264	

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-5245095	14-09-93	AU-A-	1772092	17-11-92
		CA-A-	2108016	13-10-92
		CZ-A-	9302081	16-03-94
		EP-A-	0580745	02-02-94
		JP-T-	6506689	28-07-94
		NO-A-	933630	06-12-93
		WO-A-	9218471	29-10-92
EP-A-0608027	27-07-94	NONE		
EP-A-0470923	12-02-92	US-A-	5035909	30-07-91
		CA-A-	2042105	08-02-92
		CN-A-	1058699	19-02-92
		ES-T-	2057832	16-10-94
		JP-A-	6046806	22-02-94